United States Patent

Case et al.

[15] **3,689,143**

[45] **Sept. 5, 1972**

[54] **REPRODUCING MACHINE**

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[21] Appl. No.: **101,788**

[52] **U.S. Cl.** **355/3,** 355/8, 355/11, 355/49, 355/57

[51] **Int. Cl.** **G03g 15/00**

[58] **Field of Search**.....355/3, 7, 8, 14, 16, 40, 41, 355/50, 51, 57, 72, 11, 49

[56] **References Cited**

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3,498,712 3/1970 Kolibas et al. .....355/66 X

3,283,648 11/1966 Froese 355/55

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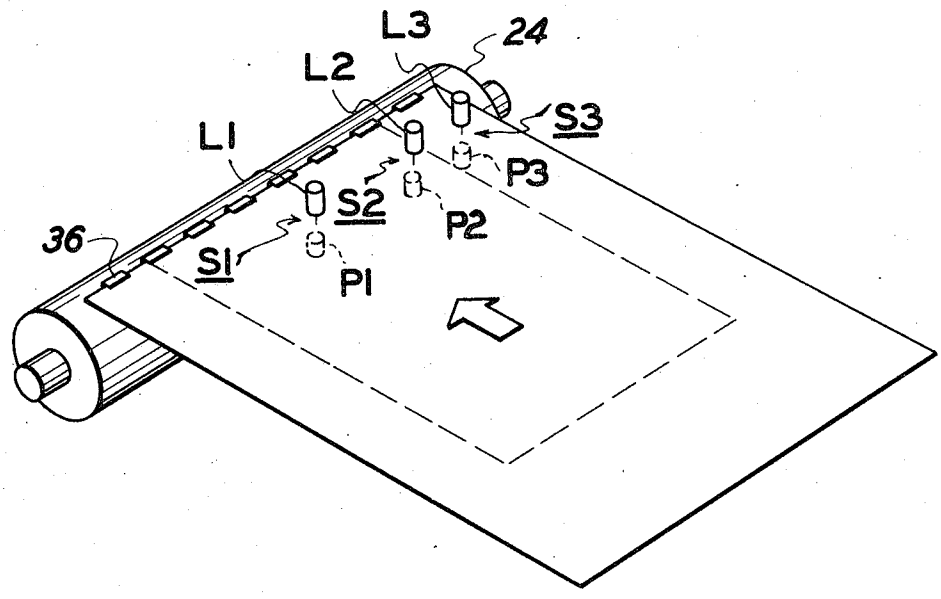
[57] **ABSTRACT**

An improved continuous and automatic xerographic reproducing machine that is adapted to create copy on sheet material of one of several sizes. The machine has a plurality of sensing devices positioned to detect the size of the document to be reproduced as it is inserted and moved into the machine prior to the initial imaging cycle. This information is translated into machine logic that selects a particular optical magnification of the image projection means, a related document speed, and a proper support tray for copy sheet size.

5 Claims, 5 Drawing Figures



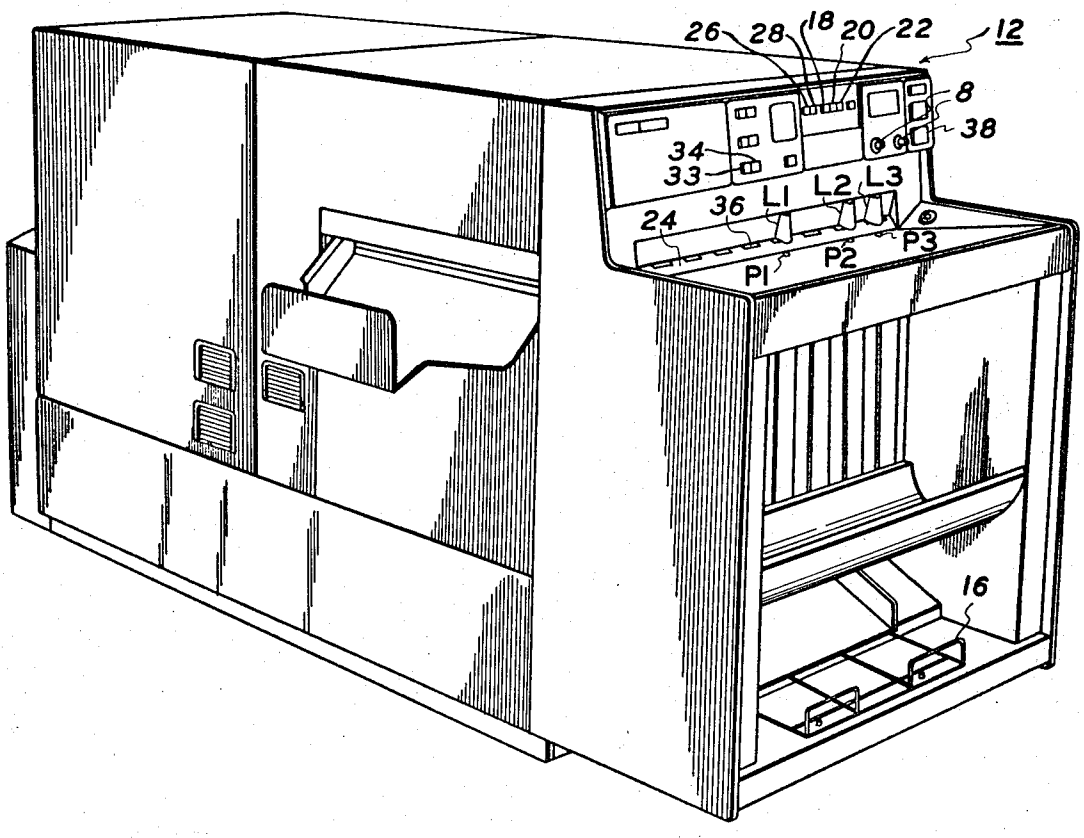


FIG. 1

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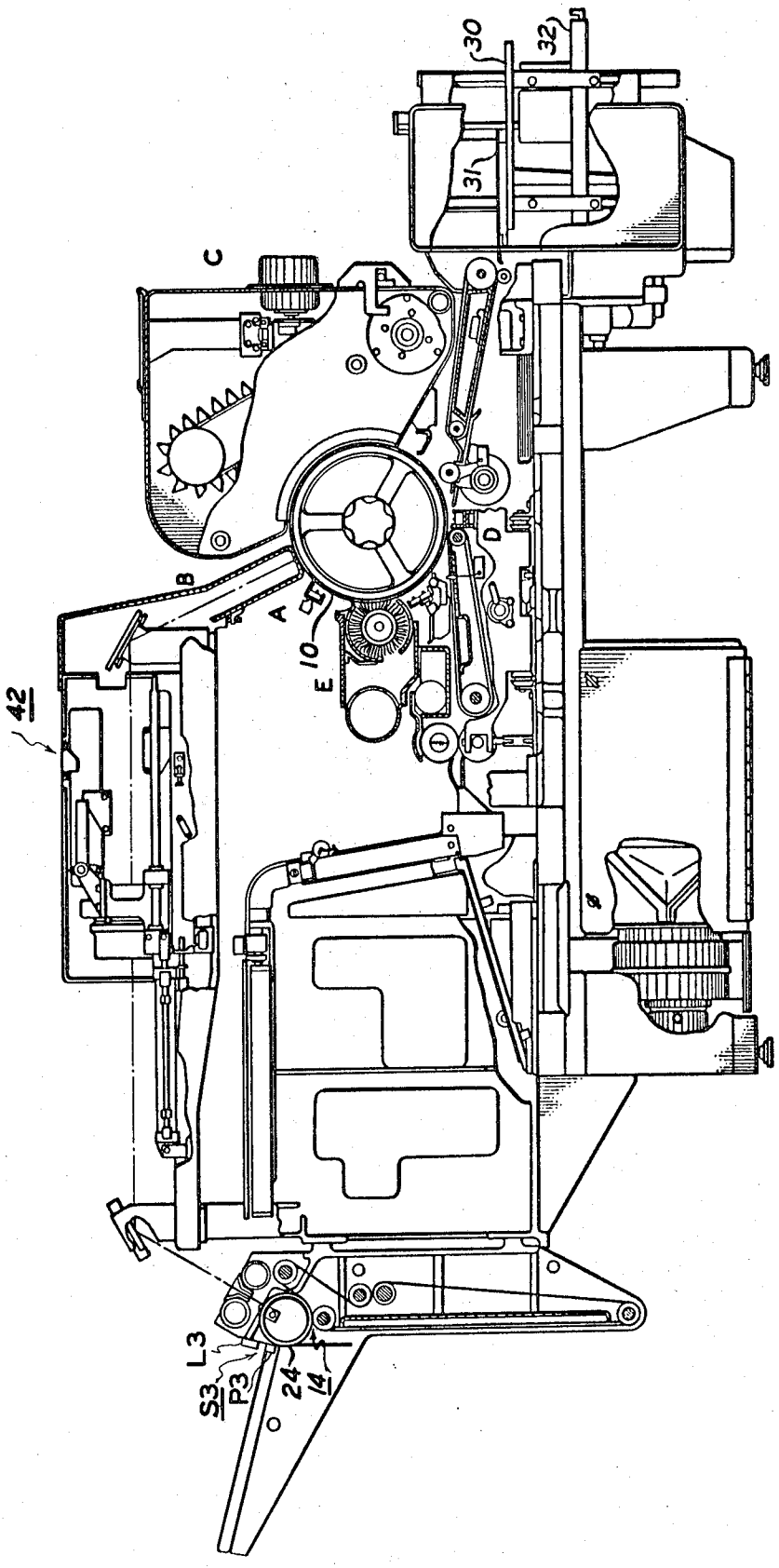

FIG. 2

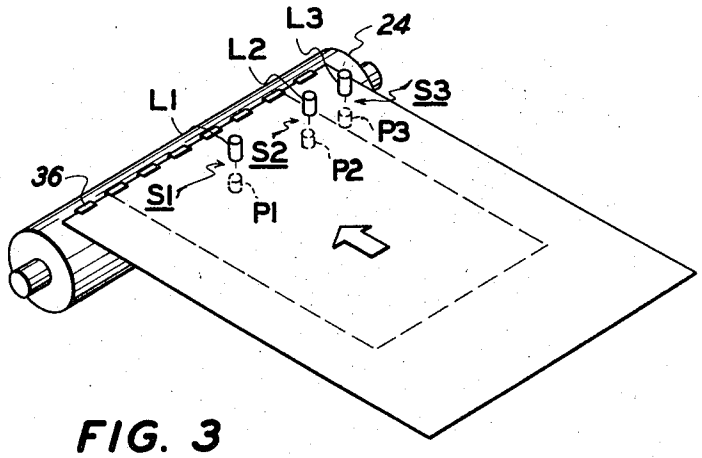

FIG. 3

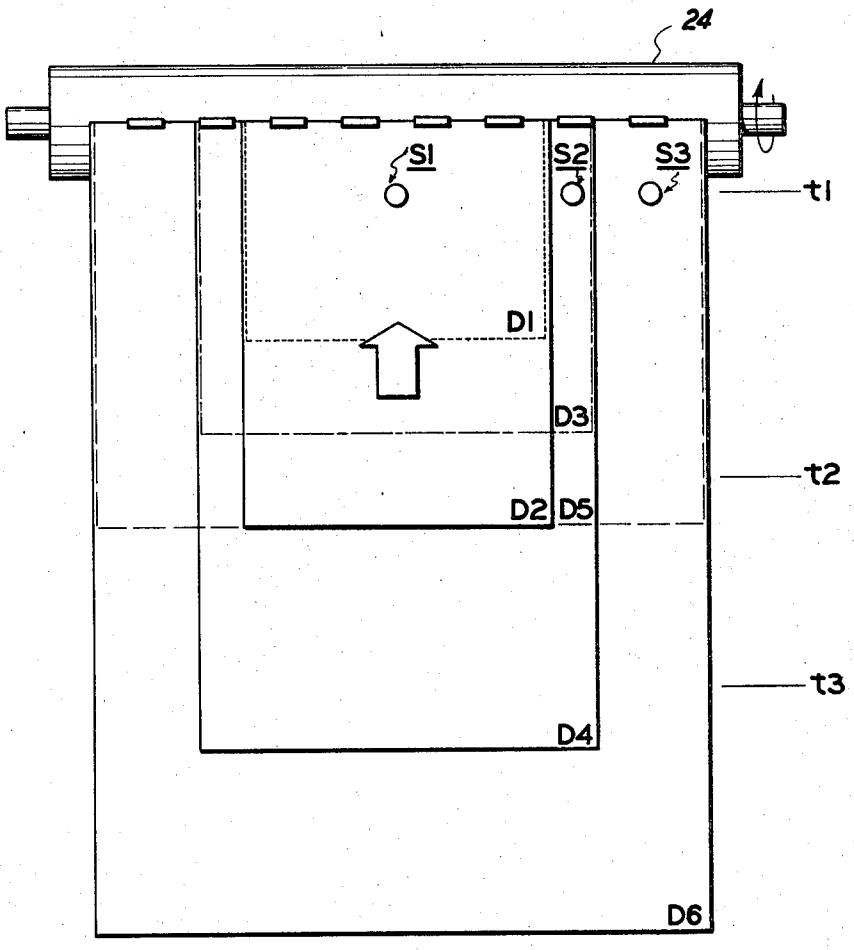

FIG. 4

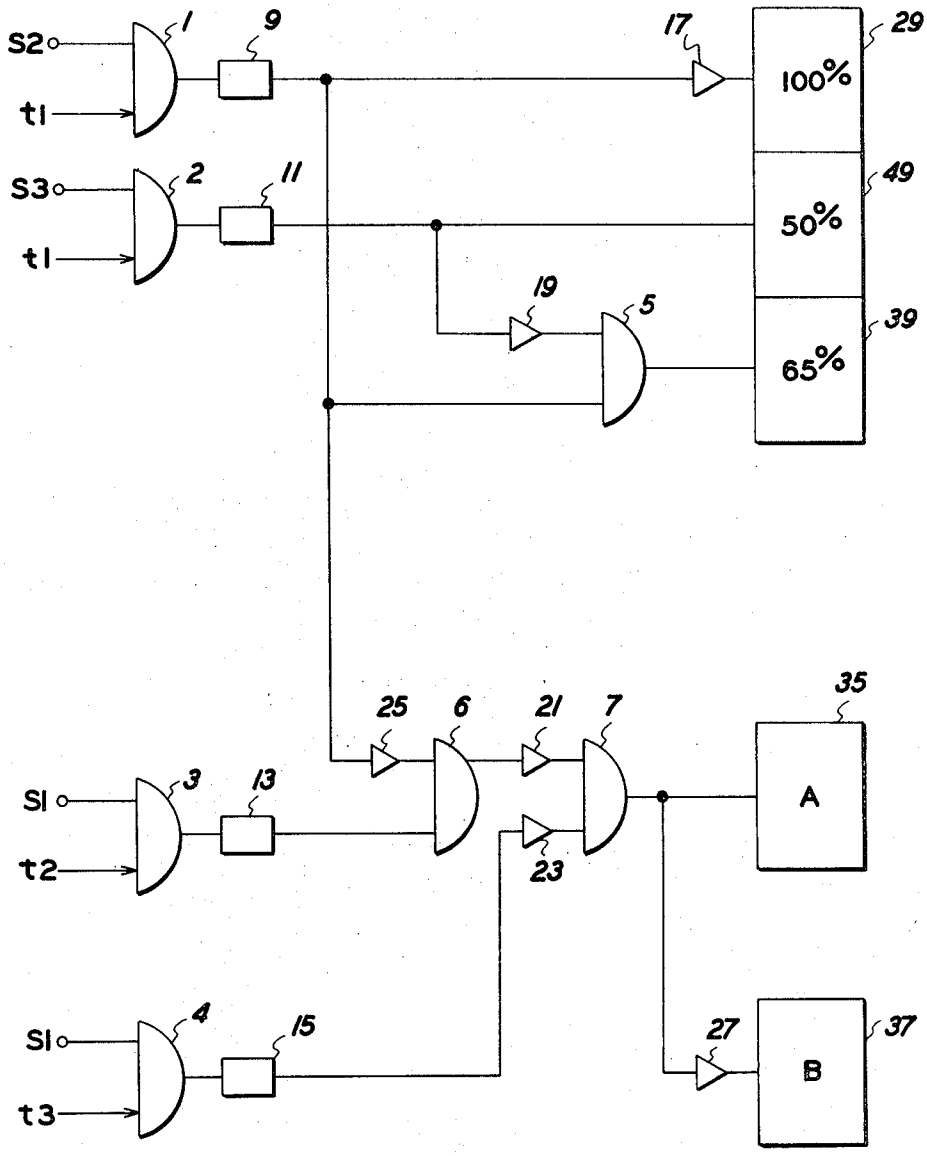
S2
t1
S3
t1
S1
t2
S1
t3
1
2
3
4
5
6
7
9
11
13
15
17
19
21
23
25
27
29
49
39
35
37
100%
50%
65%
A
B

FIG. 5

REPRODUCING MACHINE

This invention relates to an automatic mode selection system and more particularly to a document sensing system in a reproducing machine wherein the document size is correlated to a selected combination of copy sheet size and optical magnification.

In the process of xerography, as disclosed for example in U.S. Pat. No. 2,297,691 issued Oct. 6, 1942 to Chester F. Carlson, a xerographic plate comprising a layer of photoconductive insulating material on a conductive backing is given a uniform electrostatic charge. The surface is then exposed to a light or radiation pattern of the object to be reproduced to discharge the charge of the xerographic plate in light struck areas. This will create a latent electrostatic image of the object to be reproduced. Development of the image is effected with developing material comprising, in general, a mixture of suitable pigmented or dyed electroscopic powder hereinafter referred to as toner and a larger granular material called carrier, which functions to generate triboelectric charges on the toner and facilitate its handling.

In the development of the image, the toner particles are brought into surface contact with the latent electrostatic images whereupon the toner will adhere thereto in imagewise configuration. Thereafter the developed xerographic image is transferred to a support material such as paper as by electrostatic means. The xerographic surface and copy sheet are then separated to create, after fixing the toner to the support material, a permanent copy of the original object or document.

Most xerographic equipment in commercial use today is adapted to make reproductions on sheet material retained in a stack within the equipment and to create copies of originals at about a 1:1 optical rate. A significant improvement in the art is directed to an apparatus for imaging at either the 1:1 optical rate or one of a plurality of optical reduction rates while creating an undistorted reproduction of the original. This is disclosed in pending U.S. Pat. No. 3,600,066 filed in the name of George V. Del Vecchio et al. Another improvement in a continuous and automatic xerographic reproducing machine is disclosed in U.S. Pat. No. 3,589,808 filed in the name of George V. Del Vecchio whereby the machine is adapted to create copy on one of a plurality of sheet material sizes.

In the type of continuous and automatic xerographic reproducing machine of the aforementioned applications, it is necessary for the operator to select and depress a particular button on the machine console to actuate the appropriate circuit that positions the lens assembly which in turn corresponds to a particular optical magnification and a correlated document scan speed. In addition, the operator must depress the appropriate button on the control panel to actuate the circuits whereby one of the trays supporting stacks of sheet material of different sizes is positioned to feed sheet material through the machine for receiving the xerographic copy.

The present invention is directed to a mode selection system which automatically senses the size of the document to be copied and triggers the appropriate machine circuit to provide a selected combination of copy sheet size and optical magnification.

It is therefore an object of the instant invention to automatically detect the width and length of a document and to program a machine accordingly.

It is a further object of the instant invention to automatically detect the size of the document to be copied as it is inserted and moved into the machine prior to the initial imaging cycle.

It is further object of the instant invention to relay the document size information through machine logic to the preselected combination of copy sheet size, and optical magnification and correlated document scan speed that will provide a proper preselected reproduction of the document.

Further objects of the invention together with additional features and advantages thereof will become apparent from the following description of an embodiment of the invention when read in conjunction with the accompanying drawings, wherein:

FIG. **1** is a perspective view of a continuous automatic xerographic reproducing machine employing the mode selection system of the instant invention;

FIG. **2** is a schematic view of the xerographic reproducing machine as shown in FIG. **1**;

FIG. **3** is an isometric view of the mode selector sensing devices, the document drum assembly, and the document to be reproduced;

FIG. **4** is a schematic representation of documents of various sizes to be reproduced in relationship to the document drum and the document sensing devices of the instant invention; and

FIG. **5** is a schematic of the logic employed with the document sensing devices to select the appropriate optical magnification and size of sheet material for forming the copy thereon.

A typical xerographic reproducing machine which is adapted to employ the mode selector of the instant invention is shown in FIGS. **1** and **2**. The machine has a xerographic member including a photoconductive member on a conductive backing formed in the shape of drum **10**. The xerographic drum is mounted on a shaft journaled in the frame of the machine to rotate in the direction as indicated by the arrow. This movement causes the drum surface to move sequentially past the plurality of xerographic processing stations.

For the purpose of the present disclosure, the several xerographic processing stations in the path of movement of the drum surface may be described functionally as follows:

A charging station A at which a uniform electrostatic charge is deposited on the photoconductive layer of the xerographic drum;

An exposure station B at which a light or radiation pattern of a copy to be reproduced is projected onto the drum surface to dissipate the drum charge in the exposed areas thereof, thereby forming a latent electrostatic image of the copy to be reproduced;

A development station C, at which the xerographic developing material including toner particles having an electrostatic charge opposite that of the latent electrostatic image is cascaded over the drum surface whereby the toner particles adhere to the latent electrostatic image to form a xerographic powder image in the configuration of the copy being reproduced;

A transfer station D at which the xerographic powder image is electrostatically transferred from the drum

surface to the backing sheet which is moved into contact with the drum surface in registration with the toner image thereon; and

A drum cleaning and discharge station E at which the drum surface is brushed to remove residual toner particles remaining thereon after image transfer and at which the drum surface is exposed to a relatively bright light source to effect substantially complete discharge of any residual electrostatic charge remaining thereon.

The preceding description of the xerographic process is sufficient for an understanding of the instant invention. Further details of the various xerographic stations may be had by reference to U.S. Pat. No. 3,301,126 issued to Osborne et al. The embodiment of the present invention provides an automatic mode selector to the apparatus disclosed in the aforementioned pending U.S. patent applications.

In a xerographic machine of this type, the operator's basic position in operating the machine is facing the control panel **12**, document conveyor assembly **14** and first copy catch tray **16**. A substantial array of operational control buttons and dials face the operator that include buttons **18**, **20**, and **22** for controlling the lens location for optical reduction in association with the speed of rotation of the document supporting drum **24**. Also, on the control panel are the A and B buttons **26** and **28** whereby the A tray or the B tray **30** and **32** supporting stacks **31** of sheet material of different sizes may be positioned to feed sheet material through the machine for receiving the xerographic copy. Furthermore, a "FOLDER OFF" button **33** and a "FOLDER ON" button **34** are provided whereby sheet material of a larger size may be folded prior to its movement to exterior of the machine. Dials **8** permit the selection of the number of copies to be made.

The present invention relates to an independent and automatic mode selector that eliminates the operator requirement of selecting and depressing the necessary combination of buttons **18**, **20**, **22**, **26** and **28** for the proper copying of document that may vary in size. This mode selector remains in an "ON" condition, automatically senses the size of the document, and then selects the optical magnification and copy sheet size for the reproduction cycle whenever the operator does not desire to select manually by depressing the control buttons.

In using the machine, the operator places the leading edge of the document to be reproduced beneath the gripper fingers **36** of the document drum **24** which supports and feeds the document past one end of the optical path which terminates at the xerographic drum. An array of document sensing devices **S1**, **S2**, and **S3** comprising, for example, photocells **P1**, **P2**, and **P3** and cooperating lamps **L1**, **L2**, and **L3**, are located adjacent to the document drum **24** as shown in FIGS. **1** and **2**. These photocells **P1**, **P2**, and **P3** and cooperating lamps **L1**, **L2**, and **L3** detect the presence of a document after the operator inserts the document on the document drum **24** beneath gripper fingers **36**, and depresses machine cycle start button **38**. The presence of a document will stop light from a lamp to its cooperating photocell aperture. In doing so, this will cause a particular signal to be sent into the machine logic or control circuitry.

The documents to be reproduced may be of numerous but more conventional sizes that include a variety of widths and lengths. In FIG. **4**, documents **D1**, **D2**, **D3**, **D4**, **D5**, and **D6** are illustrated as having different dimensions. The document sizes are ones most commonly utilized for engineering drawings. The D designation of the documents in FIG. **4** appears in the lower right hand corner of each sheet. By way of example only, **D1** is 11 × 8 ½ inches, **D2** is 11 × 17 inches, **D4** is 17 × 22 inches, **D6** is 22 × 34 inches, and so forth. To discriminate between and accommodate these varying documents and thus provide a proper reproduction, an automatic selection of optical magnification and copy sheet size is provided.

In the preferred embodiment there are illustrated three optical magnification and rate factors, 1:1 or 100 percent, 1:0.65 or 65 percent, and 1:0.5 or 50 percent. Further details of the operation of a type of lens and optical assembly **42** that is used can be had with reference to pending U.S. Pat. No. 3,600,066. When energized, the 100 percent, 65 percent, and 50 percent optical magnification boxes **29**, **39**, and **49** of FIG. **5** control machine logic that operates the optical assembly and the speed of the document scan. Referring to FIG. **2**, supporting stacks of different sized copy receiving material such as paper sheets are shown by tray A and tray B, **30** and **32**. Preferably tray A holds A size sheets, 11 × 8 ½, while tray B holds B size sheets, 11 × 17. Further details of the operation of a type of sheet feed assembly that can be used is had with reference to DelVecchio U.S. Pat. No. 3,589,808. When energized, the copy sheet size A and B boxes **35** and **37** of FIG. **5** control machine logic that positions the proper tray in relationship to the sheet feed assembly.

In the mode selection for example, if document **D1** is equal in dimension to copy sheet size A, the mode selector will actuate the 100 percent optical position and copy sheet tray A. Likewise, if document **D2** is equal in dimension to copy sheet size B, the mode selector system will actuate the 100 percent optical position and copy sheet tray B. Document **D3** requires 65 percent optical reduction onto copy sheet size A; document **D4** requires 65 percent optical reduction onto copy sheet size B; document **D5** requires 50 percent optical reduction onto copy sheet size A; and document **D6** requires 50 percent optical reduction onto copy sheet size B. The logic or control circuitry of FIG. **5** will select these combinations as the particular document and its size is sensed by **S1**, **S2**, and **S3**.

The width of the document inserted is detected at time **t1** by the interplay of the signals from **S2** and **S3**, time **t1** being that point when the operator inserts the leading edge of the document onto the document drum **24** beneath gripper fingers **36** and depresses machine cycle start button **38**.

Pairs of documents **D1** and **D2**, **D3** and **D4**, and **D5** and **D6** which have the same widths but different lengths must also be distinguished. To accomplish this, the photocell sensor **S1** is located so that it is common to any width document that is inserted into the machine. Connected to **S1** is a timing cycle so that when the document is fed into the machine as indicated by the arrows in FIGS. **3** and **4** and moved past **S1**, a particular signal will be emitted at times **t2** and **t3** cor-

responding to either the presence or absence of the document. Movement of the document past the photocell sensors prior to the actual document scanning is always at the same speed, hence the timing cycle need not vary with the document sizes. When the signals from S1 at $t2$ and $t3$ enter the control circuit of FIG. 5 with the signals from S2 and S3 at $t1$, the optical magnification and copy sheet size will be actuated that correlate to the size of the document that is sensed.

The signals from photocell sensors S1, S2, and S3 at time $t1$, $t2$, and $t3$ are of short duration. Therefore, latches 9, 11, 13, and 15 are provided to maintain the signals received from AND gates 1, 2, 3, and 4 in the logic until there is a selection and energizing of box 35 or 37 and box 29, 39, or 49. One of two types of signals is emitted from AND gates 1, 2, 3, and 4. A signal 1 from a photocell sensor denotes the presence of a document while a signal 0 denotes the absence of a document. To energize a particular optical magnification and tray for copy sheet size, a signal 1 must be relayed to the appropriate box in FIG. 5. No actuation occurs if a signal 0 is received by box 35 or 37, or by box 29, 39, or 49.

Therefore, for document D1 the output of AND gates 1, 2, 3, and 4 is a signal 0. Output of AND gate 1 is received by box 29 through signal inverter 17 as a signal 1, thus energizing the 100 percent optical magnification system. Box 49 for 50 percent optical magnification does not respond to signal 0 of AND gate 2. Similarly, box 39 for the 65 percent optical magnification does not respond to signal 0 of AND gate 5 which has as its inputs, signal 0 of AND gate 1 and a signal 1, output of AND gate 2 through signal inverter 19. Box 35 for copy sheet size A is energized by a signal 1 from AND gate 7 which has as inputs a signal 1, output of AND gate 6 through signal inverter 21, and a signal 1, output of AND gate 4 through signal inverter 23. Input to AND gate 6 is signal 0 of AND gate 3 and a signal 0 from the output of AND gate 1 through signal inverter 25. Although box 35 for copy sheet size A is energized, box 37 for copy sheet size B does not actuate when it receives the output of AND gate 7 through signal inverter 27 as a signal 0.

If instead of D1, a document D5 is presented to the mode selector, output of AND gates 1, 2, and 3 is a signal 1. A signal 0 is the AND gate 4 output. Output of AND gate 1 is received by box 29 through signal inverter 17 as a signal 0; thus there is no actuation of the 100 percent optical magnification system. Signal 1 of AND gate 2 energizes box 49, the 50 percent optical magnification system. Box 39 for the 65 percent optical magnification does not respond to signal 0 of AND gate 5 which has as its inputs, signal 1 of AND gate 1 and a signal 0, output of AND gate 2 through signal inverter 19. Box 35 for copy sheet size A is energized by a signal 1 from AND gate 7 which has as inputs a signal 1, output of AND gate 6 through signal inverter 21, and a signal 1, output of AND gate 4 through signal inverter 23. Input to AND gate 6 is signal 1 of AND gate 3, and a signal 0 from the output of AND gate 1 through signal inverter 25. Although box 35 for copy sheet size A is energized, box 37 for copy sheet size B does not actuate when it receives the output of AND gate 7 through signal inverter 27 as a signal 0. A document D6 having the same width as D5 would emit the same signals from AND gates 1 and 2 as document D5. However, since D6 is a different length than D5, the signal from AND gate 4 would change from a signal 0 to a signal 1. This consequently changes one input signal of AND gate 7. With the input to AND gate 7 as a signal 1 and a signal 0, output of AND gate 7 is a signal 0. Box 35 for copy sheet size A does not respond to this signal 0. However, box 37 for copy sheet size B is energized when it receives the output signal of AND gate 7 through signal inverter 27 as a signal 1.

Similarly, if a D2, D3, or D4 document size is presented to the mode selector and sensed by the photocell sensors S2 and S3 at time $t1$ and S1 at times $t2$ and $t3$, the particular signals from AND gates 1, 2, 3, and 4 enter the control circuit of FIG. 5 to energize the appropriate optical magnification and copy sheet size boxes.

As can be seen from the foregoing, the mode selector automatically actuates a combination of optical magnification and copy sheet size as the particular size of the document is determined. This is accomplished by detecting the document width at time t1 with sensing devices S2 and S3 and by detecting the document length with sensing device S1 through a timing cycle $t2$ and $t3$. This information is relayed by the logic circuit to actuate the optical and sheet conveying assembly of the type of reproducing machine previously noted.

While the instant invention as to its objects and advantages has been described as carried out in a specific embodiment thereof, it is not intended to be limited thereby but to be covered broadly within the scope of the appended claims.

What is claimed is:

1. A machine for reproducing an original document onto a sheet including
   - a plurality of sheet supporting trays,
   - sheet feed means to forward a sheet from one of said trays through the reproducing machine for having a copy of the original created thereon,
   - positioning means operable to position one of said sheet supporting trays into operative sheet feeding relation with said sheet feed means,
   - optical means for projecting, along an optical path, a light pattern of a document to be reproduced,
   - second positioning means to vary the location of said optical means whereby said original is reproduced at a predetermined magnification,
   - support means for moving the document past one end of said optical path,
   - sensing means adjacent said document support means to sense the size of the document to be reproduced, and
   - control means responsive to said sensing means to actuate at least one of said positioning means to a pre-determined orientation as a function of the size of the sensed document and vary the speed of movement of the document past the optical path.

2. A reproducing machine as set forth in claim 1 wherein said sensing means are photocell sensors.

3. A reproducing machine as set forth in claim 1 wherein said sensing means includes a timing means whereby the sensing means initiates signals to said control means as the sensing means first senses the width of the document and then, as the document is moved by said support means, senses the length of the document.

4. A machine for reproducing an original document onto a sheet including:

sheet feed means to forward a sheet of copy receiving material along a path whereby a copy of an original document may be created thereon,

support means to retain a quantity of copy receiving material adjacent said sheet feed means, whereby copy receiving material may be fed therefrom,

support means to position a document to be reproduced adjacent one end of the optical path,

sensing means adjacent said document support means to sense the size of the document to be reproduced, and

means responsive to said sensing means to cause the feeding of copy receiving material from said support means at a size which is a function of the size of the sensed document.

5. A machine for reproducing an original document onto a sheet including:

a plurality of sheet supporting trays,

sheet feed means to forward a sheet from one of said trays through the reproducing machine for having a copy of the original created thereon,

positioning means to locate one of said sheet supporting trays in sheet feeding relation with said sheet feed means,

optical means for projecting, along an optical path, a light pattern of a document to be reproduced,

positioning means to vary said optical means whereby said original is reproduced at a predetermined optical rate,

support means to position a document to be reproduced adjacent one end of the optical path,

sensing means adjacent said document support means to sense the size of the document to be reproduced, and

means to actuate both of said positioning means to a predetermined orientation as a function of the sensed document.

* * * * *